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Original Article

Prevalence of Neck Pain and Disability in Bike Riders Using Different Types of Helmets in Lahore

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ABSTRACT

Background: Neck pain is a frequent musculoskeletal complaint among motorcycle riders and may be influenced by prolonged riding exposure, sustained cervical posture, vibration, and helmet-related ergonomic factors. Although helmets are essential for preventing head and facial injuries, different helmet designs may vary in their perceived cervical loading and comfort during regular motorcycle use. Objective: To determine the prevalence of neck pain and neck-related disability among male bike riders in Lahore using different types of helmets. Methods: A cross-sectional observational study was conducted among 301 male motorcycle riders aged 20–40 years in Lahore. Participants were recruited through non-probability convenience sampling. Eligible riders had used helmets for more than four months and rode motorcycles for more than two hours daily. Data were collected using a self-structured questionnaire, the Numeric Pain Rating Scale, and the Neck Disability Index. Descriptive statistics were calculated using SPSS version 22. Results: Overall, 68.0% of participants reported neck pain. Full-face helmet users reported the highest neck pain prevalence at 76.3%, followed by modular helmets at 65.3%, half-face helmets at 58.3%, and open-face helmets at 53.3%. The overall mean NDI score was 18.6 ± 6.4. Moderate disability was reported by 39.9% of participants, while moderate pain was reported by 42.5%. Conclusion: Neck pain and disability were common among male bike riders in Lahore, with the highest descriptive burden observed among full-face helmet users. Findings support ergonomic helmet selection, posture education, and preventive physiotherapy while maintaining helmet use for road-safety protection.
Keywords: Neck pain; Neck disability; Helmet use; Motorcycle riders; Numeric Pain Rating Scale; Neck Disability Index; Lahore.

INTRODUCTION

Motorcycle use is a major mode of daily transportation in many low- and middle-income urban settings, including Pakistan, where motorcycles are frequently used by students, office workers, and occupational riders for commuting and income-generating activities. Protective helmets remain an essential road-safety intervention because they reduce the risk of fatal and non-fatal head and facial injuries during road traffic crashes, and their use is therefore strongly supported from a public health perspective (1). However, while helmets are primarily designed to protect the head and face, their prolonged use may also alter mechanical loading across the cervical region, particularly when helmet weight, design, fit, visibility, ventilation, and restriction of head movement interact with sustained riding posture and road vibration. Differences between full-face, modular, half-face, and open-face helmets may therefore be clinically relevant because these helmet types vary in structural coverage, weight distribution, chin protection, field of view, and potential effects on cervical movement during riding (2).

Neck pain is a common musculoskeletal condition with a multifactorial origin, influenced by individual characteristics, repetitive physical exposure, posture, occupational demands, psychosocial factors, and

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sustained loading of cervical muscles. The global burden of neck pain has increased substantially, contributing to disability, reduced productivity, impaired quality of life, and greater healthcare utilization across adult populations (5,6). Among motorcycle riders, cervical discomfort may be further influenced by prolonged sitting, forward head posture, upper limb loading on handlebars, repetitive vibration exposure, traffic-related stress, and extended helmet use. Studies among occupational and productive adult motorcyclists have reported a considerable burden of musculoskeletal symptoms, including neck pain, suggesting that frequent riding may represent an important exposure group for cervical pain and disability (3,4,7,8).

Previous research has examined neck pain among helmet users and occupational motorcyclists, but the evidence remains limited regarding whether riders using different helmet types report different levels of neck pain and disability. Available studies suggest that helmet use, prolonged riding duration, and rider-related ergonomic factors may be associated with cervical discomfort, but many studies have focused on general helmet use rather than comparing helmet designs or quantifying disability through standardized tools such as the Neck Disability Index (NDI) and pain intensity scales (9-12). This creates a practical evidence gap for urban motorcycle riders, particularly in settings where helmet enforcement is increasing but ergonomic awareness, helmet fitting guidance, and preventive musculoskeletal education remain limited.

The present study was therefore designed to determine the prevalence of neck pain and neck-related disability among male bike riders in Lahore using different types of helmets. Using a cross-sectional observational design, the study focused on male riders aged 20–40 years who had been using helmets for more than four months and riding motorcycles for more than two hours daily. The primary research question was whether the reported prevalence of neck pain and level of neck disability differed descriptively across riders using full-face, modular, half-face, and open-face helmets. The study further aimed to provide preliminary local evidence to support ergonomic helmet selection, rider education, and preventive physiotherapy strategies while maintaining the essential role of helmets in road traffic injury prevention.

MATERIALS AND METHODS

This cross-sectional observational study was conducted in Lahore, Pakistan, over a period of six months following approval of the study protocol. The study population comprised male motorcycle riders aged 20–40 years who were university students, office workers, or professional bike riders and who used motorcycles as part of their routine daily travel. A cross-sectional design was selected because the objective was to estimate the burden of neck pain and disability at a single point in time and to describe these outcomes across different helmet-type groups rather than establish temporal or causal relationships.

Participants were recruited through non-probability convenience sampling from accessible rider populations in Lahore. Riders were screened for eligibility according to predefined inclusion and exclusion criteria. Male riders were eligible if they were 20–40 years of age, had used a motorcycle helmet for more than four months, and reported riding a motorcycle for more than two hours per day. Riders were excluded if they had a history of cervical spine fracture or injury, cervical fusion or cervical surgery, facial trauma, congenital cervical abnormality, cervical radiculopathy, impingement syndrome, or cervical spondylosis, because these conditions could independently influence neck pain, cervical function, or disability scores and thereby confound interpretation of helmet-related discomfort.

Data were collected using a self-structured questionnaire, the Numeric Pain Rating Scale (NPRS), and the Neck Disability Index (NDI). The self-structured questionnaire recorded demographic and riding-related variables, including age group, occupational status, daily riding duration, and type of helmet used. Helmet type was categorized as full-face, modular, half-face, or open-face according to participant report. Neck pain was assessed as a self-reported cervical pain complaint among eligible riders, and pain

intensity was measured using the NPRS, with responses categorized into no pain, mild pain, moderate pain, and severe pain according to the scoring approach used during data analysis. Neck-related disability was assessed using the NDI, and disability was categorized as no disability, mild disability, moderate disability, or severe disability according to standard NDI score interpretation used in the study dataset. To improve internal consistency of reporting, all outcome frequencies were planned to be presented with their corresponding denominators, and helmet-type-specific pain prevalence was planned to be reported as n/N (%) rather than percentage alone.

The primary variables of interest were helmet type, presence of neck pain, NPRS pain category, and NDI score. Age group, occupational status, and daily riding duration were treated as descriptive participant characteristics and potential confounding variables because they may influence both helmet-use patterns and neck pain. Selection bias was addressed by applying uniform eligibility criteria to all participants, while clinical confounding from pre-existing cervical disorders was reduced by excluding riders with known cervical trauma, surgery, radiculopathy, impingement syndrome, cervical spondylosis, or congenital cervical abnormalities. Because the study relied on self-reported information, recall and reporting bias were considered possible; therefore, questionnaire items were focused on directly reportable demographic, riding, helmet-use, pain, and disability information.

The final sample included 301 eligible male bike riders. Data were entered and analyzed using SPSS version 22. Descriptive statistics were used to summarize all variables. Categorical variables were presented as frequencies and percentages, while continuous NDI scores were presented as mean ± standard deviation. Helmet-type distribution, neck pain prevalence, NDI disability categories, and NPRS pain categories were summarized using exact denominators. For helmet-type-specific outcomes, neck pain prevalence was planned to be reported separately for each helmet group, and mean NDI scores were summarized by helmet type. Where complete group-wise data were available, the comparison of neck pain prevalence across helmet types could be assessed using the chi-square test or Fisher's exact test as appropriate, while differences in NDI scores across helmet groups could be assessed using one-way analysis of variance or the Kruskal–Wallis test depending on distributional assumptions. If sufficient participant-level data were available, multivariable logistic regression could be used to estimate the relationship between helmet type and neck pain after adjustment for age group, occupational status, and daily riding duration. Missing or incomplete responses were to be handled using variable-specific denominators, and records with missing helmet-type or outcome data were not to be included in helmet-specific analyses for that variable. Statistical significance, where inferential testing was performed, was assessed at a p-value of less than 0.05. Data integrity was maintained by applying consistent eligibility criteria, using standardized outcome instruments for pain intensity and neck disability, coding helmet categories before analysis, and checking frequency totals and percentages against the overall sample size and subgroup denominators. The analysis was kept aligned with the observational cross-sectional design; therefore, findings were interpreted as descriptive patterns or statistical associations where tested, without making causal claims regarding helmet type and neck pain.

RESULTS

A total of 301 male motorcycle riders were included in the analysis. The largest age group was 31–35 years, comprising 113 participants (37.5%), followed by 36–40 years with 76 participants (25.2%), 26–30 years with 61 participants (20.3%), and 20–25 years with 51 participants (16.9%). Most participants were employed, while approximately one-third were students. Daily riding exposure was highest among riders who reported four hours of motorcycle use per day.

The participant profile indicates that the study sample mainly represented adult working-age motorcycle riders, with nearly two-thirds being employed. The highest proportion of riders belonged to the 31–35-year age group, and the most frequently reported daily riding duration was four hours, suggesting that a substantial proportion of participants had regular prolonged riding exposure. Helmet-use data were

available for 298 participants, while helmet type was not specified for three participants. Full-face helmets were the most frequently reported helmet type, followed closely by modular helmets. Half-face and open-face helmets were less frequently used.

Table 1. Demographic and Riding Characteristics of Participants

Variable	Category	n (%)
Age group	20–25 years	51 (16.9)
	26–30 years	61 (20.3)
	31–35 years	113 (37.5)
	36–40 years	76 (25.2)
Occupational status	Student	109 (36.2)
	Employed	192 (63.8)
Daily riding duration	2 hours	73 (24.3)
	3 hours	105 (34.9)
	4 hours	123 (40.9)

Table 2. Distribution of Helmet Types Among Motorcycle Riders

Helmet Type	n (%)
Full-face	88 (29.2)
Modular	85 (28.2)
Half-face	72 (23.9)
Open-face	53 (17.6)
Missing/not specified	3 (1.0)
Total	301 (100.0)

Full-face and modular helmets together accounted for more than half of all helmet use in the sample. The corrected percentage for half-face helmet use was 23.9% based on the total sample of 301 participants. Three participants had no specified helmet type, which explains the discrepancy between the total sample size and the helmet-type frequencies reported in the manuscript.

Overall neck pain prevalence was reported as 68.0%. When examined descriptively by helmet type, the highest reported neck pain prevalence was observed among full-face helmet users, followed by modular, half-face, and open-face helmet users.

Table 3. Neck Pain Prevalence According to Helmet Type

Helmet Type	Denominator	Neck Pain Prevalence (%)
Overall sample	301	68.0
Full-face	88	76.3
Modular	85	65.3
Half-face	72	58.3
Open-face	53	53.3

Neck pain was reported by more than two-thirds of the overall sample. Full-face helmet users had the highest reported prevalence of neck pain at 76.3%, whereas open-face helmet users had the lowest reported prevalence at 53.3%. These findings suggest a descriptive gradient in reported neck pain across helmet types, but statistical comparison cannot be confirmed from the available manuscript data because exact pain counts by helmet type and inferential test results were not provided.

Neck-related disability was assessed using the Neck Disability Index. The overall mean NDI score was 18.6 ± 6.4. The most common disability category was moderate disability, followed by mild disability. Severe disability was reported in a smaller proportion of participants.

Table 4. Neck Disability Index Categories Among Participants

Disability Level	n (%)
No disability	49 (16.3)
Mild disability	112 (37.2)
Moderate disability	120 (39.9)
Severe disability	20 (6.6)
Total	301 (100.0)

Moderate disability was the most frequent NDI category, affecting 120 participants (39.9%), while mild disability was reported by 112 participants (37.2%). Only 49 participants (16.3%) reported no disability, indicating that most riders experienced some degree of neck-related functional limitation. Severe disability was present in 20 participants (6.6%), representing a smaller but clinically important subgroup. Mean NDI scores varied across helmet types. Full-face helmet users had the highest mean NDI score, while open-face helmet users had the lowest mean NDI score.

Table 5. Mean Neck Disability Index Score According to Helmet Type

Helmet Type	Mean ± SD
Full-face	21.2 ± 6.1
Modular	18.4 ± 5.9
Half-face	16.2 ± 5.3
Open-face	15.5 ± 4.8
Overall sample	18.6 ± 6.4

The mean NDI score was highest among full-face helmet users at 21.2 ± 6.1 and lowest among open-face helmet users at 15.5 ± 4.8. Modular helmet users had a mean NDI score of 18.4 ± 5.9, while half-face helmet users had a mean score of 16.2 ± 5.3. The pattern indicates higher reported disability among riders using helmets with greater structural coverage; however, the available manuscript data do not include p-values, confidence intervals, or effect sizes to confirm whether these differences were statistically significant. Pain intensity was categorized using the Numeric Pain Rating Scale. Moderate pain was the most frequently reported NPRS category, followed by mild pain. Severe pain was reported by 49 participants.

Table 6. Numeric Pain Rating Scale Categories Among Participants

Pain Category	n (%)
No pain	25 (8.3)
Mild pain	99 (32.9)
Moderate pain	128 (42.5)
Severe pain	49 (16.3)
Total	301 (100.0)

Moderate pain was reported by 128 participants (42.5%), making it the most common NPRS category. Mild pain was reported by 99 participants (32.9%), and severe pain was reported by 49 participants (16.3%). Only 25 participants (8.3%) reported no pain on the NPRS. This distribution indicates that pain symptoms were common in the study sample; however, the NPRS distribution requires clarification against the separately reported overall neck pain prevalence of 68.0%, because the NPRS table suggests that 91.7% of participants reported some degree of pain.

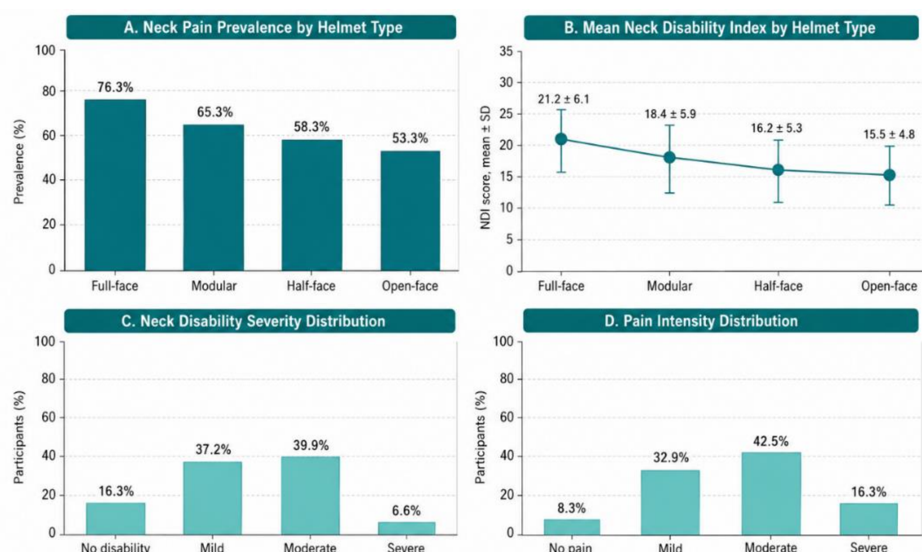

Figure 1 Helmet Type, Neck Pain Prevalence, Disability, and Pain Intensity Among Motorcycle Riders

The panelled figure demonstrates a clinically relevant gradient across helmet types, with full-face helmet users showing the highest reported neck pain prevalence at 76.3% and the highest mean NDI score at 21.2 ± 6.1, followed by modular helmet users with 65.3% neck pain prevalence and a mean NDI score of 18.4 ± 5.9. Half-face and open-face helmet users showed comparatively lower reported neck pain prevalence at 58.3% and 53.3%, respectively, with corresponding mean NDI scores of 16.2 ± 5.3 and 15.5 ± 4.8. The disability distribution further indicates that moderate disability was the most frequent NDI category, affecting 39.9% of participants, while mild disability was reported by 37.2%, severe disability by 6.6%, and no disability by 16.3%. Pain intensity followed a similar burden pattern, with moderate pain reported by 42.5% of riders, mild pain by 32.9%, severe pain by 16.3%, and no pain by 8.3%. Together, these aggregate patterns suggest that riders using more structurally enclosed helmets reported greater neck pain and disability, although these findings remain descriptive because inferential statistics, confidence intervals, and adjusted estimates were not available.

DISCUSSION

The present cross-sectional study identified a considerable burden of neck pain and neck-related disability among male motorcycle riders in Lahore who reported regular helmet use and daily motorcycle riding exposure. Overall, neck pain was reported in 68.0% of participants, while moderate pain was the most frequent NPRS category and moderate disability was the most frequent NDI category. When outcomes were examined descriptively across helmet types, full-face helmet users reported the highest neck pain prevalence and the highest mean NDI score, followed by modular, half-face, and open-face helmet users. These findings suggest that riders using helmets with greater structural coverage may experience a higher burden of cervical discomfort and functional limitation; however, the results should be interpreted as descriptive patterns rather than causal effects because the study was cross-sectional and did not include inferential testing, adjusted estimates, objective helmet-weight measurement, posture assessment, or participant-level biomechanical evaluation.

The high prevalence of neck pain observed in this study is consistent with existing evidence showing that motorcycle riders, particularly those with prolonged riding exposure, are vulnerable to musculoskeletal symptoms involving the cervical and upper body regions. Previous studies among occupational and productive adult motorcyclists have reported neck pain as a frequent complaint, with contributing factors including riding duration, sustained posture, vibration exposure, repetitive loading, and ergonomic stress during motorcycle use (3,4,7,8). The present findings add local descriptive evidence from Lahore and indicate that neck pain is not limited to occupational riders alone, as the sample included students, office workers, and professional bike riders who used motorcycles regularly. This broader rider profile is clinically important because motorcycle commuting is common in urban Pakistan, and even non-occupational riders may accumulate sufficient daily exposure to develop musculoskeletal symptoms.

The descriptive gradient observed across helmet types may be clinically meaningful, although it requires confirmation through more robust analytic methods. Full-face helmet users reported the highest neck pain prevalence at 76.3% and the highest mean NDI score of 21.2 ± 6.1, whereas open-face helmet users reported the lowest neck pain prevalence at 53.3% and the lowest mean NDI score of 15.5 ± 4.8. This pattern may reflect differences in helmet structure, coverage, weight distribution, ventilation, visibility, and restriction of cervical movement. Full-face and modular helmets provide greater craniofacial protection and are strongly relevant for injury prevention, but their design may also increase perceived cervical load during prolonged riding, particularly when combined with forward head posture, traffic exposure, and repeated road vibration. Similar concerns have been raised in studies evaluating helmet-related neck discomfort and the relationship between helmet use and cervical disability among motorcyclists (10-12). Nevertheless, the present study did not directly measure helmet weight, helmet fit, aerodynamic drag, cervical muscle endurance, or posture, and therefore these mechanisms remain plausible explanations rather than directly demonstrated causal pathways.

The findings should also be interpreted in light of the protective role of helmets. Evidence from motorcycle safety research consistently supports helmet use for reducing head, facial, and traumatic injury risk, and the present results should not be interpreted as discouraging helmet use (1,2). Instead, the study highlights the need to consider helmet ergonomics alongside road-safety benefits. The public health message should therefore emphasize correct helmet use, appropriate helmet fit, selection of certified helmets with ergonomic design, and rider education on cervical posture and rest strategies. For frequent riders, preventive physiotherapy advice, neck strengthening, stretching, posture correction, and awareness of early cervical symptoms may help reduce disability while maintaining helmet compliance.

The NDI findings further indicate that neck discomfort among riders may translate into functional limitation rather than remaining a minor symptom. Moderate disability was reported by 39.9% of participants, mild disability by 37.2%, and severe disability by 6.6%. These proportions suggest that a large segment of riders experienced some degree of interference in daily activities. This is consistent with the broader epidemiological burden of neck pain, which is recognized as a major contributor to disability and reduced quality of life worldwide (5,6). In the context of daily motorcycle riding, even mild-to-moderate disability may affect work productivity, commuting comfort, concentration during riding, and long-term musculoskeletal health. The clinical relevance of these findings is strengthened by the simultaneous presence of moderate pain intensity in 42.5% of participants and severe pain in 16.3%.

Several methodological issues must be considered when interpreting the results. The study used a convenience sampling approach, which may limit representativeness and introduce selection bias. Only male riders aged 20–40 years were included, so the findings cannot be generalized to female riders, older riders, adolescents, or riders in other cities without caution. The study relied on self-reported questionnaire responses, which may introduce recall bias and reporting bias. The cross-sectional design prevents determination of temporality, meaning it cannot establish whether helmet type contributed to neck pain or whether riders with pre-existing discomfort selected particular helmet types. In addition, important potential confounders such as body mass index, motorcycle type, road conditions, riding posture, helmet weight, helmet fit, previous work-related strain, physical activity level, psychosocial stress, and cervical muscle strength were not objectively measured. The absence of inferential statistics, confidence intervals, and adjusted regression models also limits the strength of comparative conclusions across helmet types.

A further reporting issue requiring clarification is the discrepancy between the overall reported neck pain prevalence and the NPRS category distribution. Overall neck pain prevalence was reported as 68.0%, whereas the NPRS categories show that only 8.3% of participants reported no pain, implying that 91.7% reported some degree of pain intensity. This difference may reflect different definitions or timeframes for neck pain versus current pain intensity, but it must be clarified in the final manuscript to avoid misinterpretation. Similarly, helmet-type frequencies initially summed to 298 rather than the total sample of 301, requiring either correction of the original dataset or reporting of three missing helmet-type responses. These issues should be resolved before submission because accurate denominators are essential for prevalence studies and for interpretation of helmet-type comparisons.

Future research should use probability-based or multicenter sampling to improve generalizability and should include both male and female riders from multiple urban and semi-urban settings. Longitudinal designs would be valuable for determining whether helmet-related exposure precedes development or worsening of neck pain. Objective assessments such as helmet weight measurement, cervical range of motion, posture analysis, riding-duration logs, vibration exposure, motorcycle type, and ergonomic helmet-fit assessment would strengthen causal interpretation. Where participant-level data are available, future analyses should include chi-square testing for categorical pain outcomes, ANOVA or Kruskal–Wallis testing for NDI differences, and multivariable regression models adjusted for age, occupation, daily riding duration, and other relevant confounders. Such work would help identify whether helmet

type independently contributes to neck pain and disability or whether the observed differences are explained by rider characteristics and exposure patterns.

CONCLUSION

This study found a substantial descriptive burden of neck pain and neck-related disability among male motorcycle riders in Lahore, with 68.0% reporting neck pain and most participants reporting some degree of pain intensity or functional limitation. Full-face helmet users showed the highest reported neck pain prevalence and mean NDI score, while open-face helmet users showed comparatively lower values; however, these findings should be interpreted cautiously because the cross-sectional design, convenience sampling, self-reported outcomes, unmeasured ergonomic factors, and absence of adjusted inferential analysis prevent causal interpretation. The findings support the need for rider education on ergonomic helmet selection, proper helmet fit, posture awareness, and preventive physiotherapy strategies while reinforcing that helmet use remains essential for road traffic injury prevention. Future studies should use objective ergonomic assessment and adjusted statistical modeling to clarify the relationship between helmet type, riding exposure, neck pain, and disability.

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